43. (New) The magnetic storage system of claim 41, wherein a distance between a center of film thickness of the first ferromagnetic film and one of the upper and lower magnetic shields through the nonmagnetic high-conductivity layer is equal or smaller than a distance between the center of film thickness of the first ferromagnetic film and another one of the upper and lower magnetic shields through the second ferromagnetic film.

REMARKS

Favorable consideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 29-33 and 37-43 are pending in the present application. Claims 29-31 and 33 have been amended, and Claims 37-43 have been added by the present amendment.

This application is a continuation-type application of parent U.S. Application Serial No. 09/332,440, filed on June 14, 1999. In more detail, in the parent application, original Claims 4-8 and 18 were indicated as allowable. To place the parent application in condition for allowance, the original independent claims were cancelled and several indicated allowable dependent claims were rewritten in independent form.

Further, the first Office Action in the parent application mailed March 13, 2001, rejected Claims 1-3, 9-17, 19-21 and 29-36 under 35 U.S.C. §102(b) as anticipated by Gurney '157 or Heim '185. Accordingly, arguments will now be presented distinguishing independent Claims 29-33 over Gurney and Heim (both of which are discussed in the present application).

Comparative case 2 beginning at line 2 of page 36 of the present specification relates to the spin filter described in Gurney. In more detail, as noted in comparative case 2, Gurney is directed to a spin filter structure for increasing conductance variation, but a good

bias point or asymmetry cannot be realized in the Gurney' spin filter structure (as illustrated in Figs. 12 and 15 of the present invention).

In more detail, Gurney does not teach or suggest anything about a bias point or asymmetry. Gurney is also silent about the effects due to the reduction of current magnetic fields acting on the free layer (which is discussed at pages 26-33 of the present specification). In addition, Gurney does not teach or suggest anything about a stray magnetic field Hpin leaking from the pinned layer and applied to the free layer (note the relationship between a bias point and asymmetry is illustrated in Fig. 8 of the present specification).

On the other hand, as described in the comparative example 4 beginning at line 8 of page 43 of the present invention, a synthetic structure disclosed in Heim achieves a good bias point in the region of a thick free layer. Namely, the synthetic structure in the comparative example 4 results in a good bias point.

However, the present inventors found that the synthetic structure in Heim did not result in a good bias point or good asymmetry in a thin free layer, specifically when the thickness of the magnetic film is not greater than 4.0nm (see Figs. 14 and 15).

To solve this problem, the present inventors advantageously determined that a suitable high conductive layer reduces current magnetic fields that are applied to the free layer and also reduces MR (magnetoresistance). Therefore, the present invention relates to a synthetic structure together with a spin filter structure, so that the magnetic fields applied to the free layer can be reduced to obtain a good bias point and asymmetry even with a very thin free layer.

Furthermore, Heim merely discloses a free layer made of NiFe having a thickness of 70Å, but does not mention any about a thin free layer as described in the present specification. Rather, Heim uses thick free layers, and does not consider the use of thin free

layers (as discussed in the present specification, a good bias point becomes more difficult as the free layer is thinner). That is, because the thicker free layer is relatively dull in magnetic field sensitivity, a good bias point is easily achieved. In fact, Heim teaches that for a thick free layer dull in magnetic sensitivity, just the synthetic technique would make the magnetic field applied to the free layer zero. For example, Heim states in col. 5, lines 58-61, "Thus, there is essentially no magnetic dipole field generated by the pinned layer 70, and thus no magnetic field to affect the direction of magnetization 64 of the free ferromagnetic layer 63".

In summary, Heim does not teach or suggest any need for reducing the current magnetic field to realize a good bias point, and rather assumes the structure in the comparative example 4 alone would realize a good bias point.

Further, Heim discloses that a film thickness difference is provided between the upper and lower pinned layers intentionally via Ru (ruthenium), and therefore teaches a condition that the stray magnetic field from the pinned layer is not absolutely zero. However, Heim is silent as to a current magnetic field applied to a free layer.

That is, Heim states in column 6, lines 52-59, "However, it may be desirable to deliberately deposit one of the pinned ferromagnetic films to a thickness slightly greater than that of the other film so that there would be a small nonzero net magnetic moment in the pinned layer. This would assure that the magnetization of the pinned layer 70 is stable in the presence of small magnetic fields so that the direction of its magnetization is predictable."

Therefore, this passage also supports the position that Heim does not teach or suggest any need for reducing the current magnetic field to realize a good bias point, and rather assumes the synthetic structure alone in the comparative example 4 would realize a good bias point.

Further, Gurney is also silent about the current magnetic field, bias point, and asymmetry. Accordingly, it is respectfully submitted there is no motivation to combine Gurney with Heim. In summary, and as described above, realizing good asymmetry due to the spin filter structure and synthetic structure is not just a combination of the Gurney and Heim.

Accordingly, it is respectfully submitted Claims 29-33 are allowable.

In addition, new Claims 37-43 have been added to set forth the invention in a varying scope, and Applicants submit they are supported by the originally filed specification. In particular, new Claims 37-38 are directed to a recording/reproducing magnetic head as disclosed at page 201, line 10 to page 204, line 15 and as shown in Figures 44 and 45. New Claims 39-43 correspond to a magnetic storage system as disclosed at page 205, line 9 to page 206, line 9 and as shown in Figure 47. Each of the new independent claims also includes subject matter recited in Claims 29, 30 or 31. Therefore, similar arguments apply to the patentability of the new claims as those discussed above with respect to Claims 29, 30 and 31.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Claims 1-28 and 34-36 (Canceled).

Please amend Claims 29-31 and 33 as follows:

--29. (Amended) A magnetoresistance effect element, comprising:

a magnetoresistance effect film[, having] including,

a nonmagnetic spacer layer, and

first and second ferromagnetic [layer] layers separated by the nonmagnetic spacer layer, a magnetization direction of the first ferromagnetic layer being at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in [signal] a magnetic field signal;

a pair of electrodes coupled to the magnetoresistance effect film and having respective inner edges; and

a pair of longitudinal biasing layers for providing bias magnetic fields to the first ferromagnetic layer in parallel with a longitudinal direction of the first ferromagnetic layer and having respective inner edges, [wherein the] <u>said</u> inner edges of the pair of electrodes [are] <u>being</u> disposed between the inner edges of the pair of longitudinal biasing layers.

30. (Amended) A magnetoresistance effect element, comprising:

a nonmagnetic spacer layer;

first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, a magnetoresistance effect-improving layer comprising a plurality of metal films and disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic spacer layer and the magnetoresistance effect-improving layer, one of the plurality of metal films disposed in contact with the first ferromagnetic layer contains <u>a</u> metal element of not solid solution with <u>a</u> metal element of the first ferromagnetic layer; and

a nonmagnetic underlayer or a nonmagnetic protecting layer disposed in contact with the magnetoresistance effect-improving layer so that the magnetoresistance effect-improving layer is disposed between the first ferromagnetic layer and the nonmagnetic underlayer or the nonmagnetic protecting layer.

31. (Amended) A magnetoresistance effect head, comprising<u>:</u>

a magnetoresistance effect element [having] <u>including,</u>

a nonmagnetic spacer layer,

first and second ferromagnetic [layer] <u>layers</u> separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle

relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, and

a nonmagnetic high-conductivity layer disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic high-conductivity layer and the nonmagnetic spacer layer; and

upper and lower magnetic shields sandwiching the magnetoresistance effect element through respective ones of upper and lower magnetic gaps.

32. (Amended) The magnetoresistance effect head of claim 31, [further comprising upper and lower magnetic shields sandwiching the magnetoresistance effect element through respective ones of upper and lower magnetic gaps,] wherein an average surface roughness of an upper surface of the lower magnetic gap is smaller than a thickness of the antiferromagnetically coupling film.

33. (Amended) The magnetoresistance effect head of claim 31, wherein [the] a distance between a center of film thickness of the first ferromagnetic film and one of the pair of magnetic shields through the nonmagnetic high-conductivity layer is equal or smaller than a distance between the center of film thickness and another one of the pair of magnetic shields through the second ferromagnetic film.--